Savannah River Site
Solid Waste Management Department
Consolidated Incinerator Facility
Operator Training Program

AIR MONITORING SYSTEM (U)

Study Guide

ZIOITX57

Revision 00

Training Manager / Date

Engineering Manager / Date

Facility Manager / Date

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REVISION LOG

REV.	AFFECTED SECTION(S)	SUMMARY OF CHANGE
01	All	New Issue

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REFERENCES

1. 261-AOP-AM-01, *CIF Radiation Continuous Air Monitoring and Vacuum Events*, Rev. 0
2. 261-AOP-RS-9562, *CIF Response to Radioactive, Hazardous, and Petroleum Releases*, Rev. 0
3. 261-EOP-03, *Low Energy Liquid Release (LELR)*, Rev. 2
4. 261-GOP-04, *Process Shutdown From Normal Operations To Warm Stand-by*, Rev. 1
5. 261-SOP-AM-01, *Air Monitoring*, Rev. 0
6. 261-SUR-AM-01, *CIF General Air Sampling with CAM/RAS Monitoring Systems*, Rev. 0, Draft B
7. BPF 216915, *Beta Radiation Air Monitor*
8. Drawing W813850, *Radiation Monitor Vacuum System, sheet 1*, Rev. 29
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14. Drawing W841033, *Radiation Monitor Cont. Air Instrument Control Diagram*, Rev. 16
15. Drawing W841035, *Radiation Monitor/Kanne Chambers*, Rev. 12
16. J-DCF-H-00867, *Air Samples in Retrospective Mode*, Approval Copy 11/2/95
17. J-JX-H-0020, *Setpoint Index for Consolidated Incineration Facility*, Rev. 3
18. WSRC-SA-17, *Consolidated Incineration Facility Safety Analysis Report*, DOE Approval Copy 12/95
19. ZIOISX07, Air Monitoring System Design Description, Rev. 01

LEARNING OBJECTIVES

TERMINAL OBJECTIVE

1.0 Without references, **EXPLAIN** the significance of the Air Monitoring System to Consolidated Incinerator Facility operations, including it's importance to safety, and the impact on operations of a failure of the system.

ENABLING LEARNING OBJECTIVES

1.1 **STATE** the purpose of the Air Monitoring System.

1.2 **DESCRIBE** how the Air Monitoring System accomplishes it's intended purpose.

1.3 **EXPLAIN** the consequences of a failure of the Air Monitoring System to fulfill it's intended purpose, including the effects on other systems or components, overall plant operation, and safety.

TERMINAL OBJECTIVE

2.0 Using system diagrams, **EVALUATE** potential problems which could interfere with normal Air Monitoring System flow paths to determine their significance on overall system operation and the corrective actions needed to return the system to normal.

ENABLING LEARNING OBJECTIVES

2.1 **DESCRIBE** the physical layout of the Air Monitoring System components including, the general location, how many there are, and functional relationship for each of the following major components:

a. CIF Building Continuous Air Monitor Vacuum Blowers
b. Tank Farm Continuous Air Monitor Vacuum Blowers
c. Beta Monitors
d. Kanne Monitor

2.2 **DESCRIBE** the Air Monitoring System arrangement for the CIF Building to include a drawing showing the following system components and interfaces with other systems:

a. CIF Building Continuous Air Monitor Vacuum Blowers
b. Silencers
c. Filters
d. Relief valves

e. Pressure gauges
f. D/P detectors and switches
g. Temperature switches
h. Interface with Main Exhaust System

2.3 **DESCRIBE** the Air Monitoring System arrangement for the Tank Farm to include a drawing showing the following system components and interfaces with other systems:

a. Tank Farm Continuous Air Monitor Vacuum Blowers
b. Silencers
c. Filters
d. Relief valves
e. Pressure gauges
f. D/P detectors and switches
g. Temperature switches
h. Interface with Tank Farm exhaust stack

2.4 Given a description of abnormal equipment status for the Air Monitoring System, **EXPLAIN** the significance of the condition on system operation.

2.5 Given a description of the Air Monitoring System equipment status, **STATE** any corrective actions required to return system operation to a normal condition.

TERMINAL OBJECTIVE

3.0 Given values of Air Monitoring System operation parameters, **EVALUATE** potential problems that could effect the normal functioning of the system or it's components to determine the significance of the existing condition and the actions required to return the system to normal operation.

ENABLING LEARNING OBJECTIVES

3.1 **DESCRIBE** the following major components of the Air Monitoring System including their functions, principles of operation, power supplies, and basic construction:

a. Vacuum blowers
b. Beta detectors
c. Kanne Tritium Radiation Monitor
d. Count rate meters
e. Local alarm panels

3.2 Given values for key performance indicators, **DETERMINE** if Air Monitoring System components are functioning as expected.

3.3 **DESCRIBE** the following Air Monitoring System instrumentation including, indicator location, (local or Control Room) sensing points, and associated instrument controls.

a. Pressure gauges
b. D/P detectors and switches
c. Temperature switches
d. Flow meters
e. Count rate meter

3.4 **INTERPRET** the following Air Monitoring System alarms, including the conditions causing alarm actuation and the basis for the alarms:

a. Radiation alarm
b. High CAM vacuum temperature
c. High differential pressure
d. Low flow
e. Monitor Failure

3.5 **EXPLAIN** how the following Air Monitoring System equipment is controlled in all operating modes or conditions to include: control locations (local or Control Room), basic operating principles of control devices, and the effects of each control on the component operation.

a. CIF Building Continuous Air Monitor Vacuum Blowers
b. Tank Farm Continuous Air Monitor Vacuum Blowers

TERMINAL OBJECTIVE

4.0 Given necessary procedures or other technical documents and system conditions, **DETERMINE** the operator actions required for normal and abnormal operation of the Air Monitoring System including problem recognition and resolution.

ENABLING LEARNING OBJECTIVES

4.1 **STATE** the personnel safety concerns associated with the Air Monitoring System.

4.2 Given applicable procedures and plant conditions, **DETERMINE** the actions necessary to perform the following Air Monitoring System operations:

a. Startup

b. Shutdown

4.3 **DETERMINE** the effects on the Air Monitoring System and the integrated plant response when given any of the following:

a. Indications/alarms

b. Malfunctions/failure of components

c. Operator Actions

SYSTEM OVERVIEW

ELO 4.1	**STATE the personnel safety concerns associated with the Air Monitoring System.**

Safety

Normal operation of the Air Monitoring System presents limited safety hazards for operators. The continuous air monitor vacuum blowers presents potential noise, high temperature, and rotating machinery hazards. The glass casing of the flow meters could shatter if exposed to high pressure conditions. As with any electrical system, the potential for dangerous voltage exists when electrical leads or panels are open or exposed. Follow the safety practices as required in Manual 8Q, Employee Safety Manual.

The Air Monitoring System is designed to detect high airborne particulate activity in the facility. In the event of a High Radiation Alarm from a Continuous Air Monitoring (CAM) detector, personnel will evacuate the effected areas, and RCO personnel will monitor for personnel contamination and enter the area to continue monitoring for activity at the detector. If the activity is above the limit (i.e. not a detector malfunction), then personnel will be required to wear appropriate protective gear when returning to the area.

The presence of high airborne activity may indicate a potential leak from a process system. When operators reenter an area with high airborne activity, effort should be made to locate and stop the source of the airborne activity, since this activity could potentially be released to the environment if problems occurred in the exhaust systems.

Introduction

The Consolidated Incineration Facility (CIF) is operated to reduce the volume of wastes generated by the Savannah River Site. Materials that are transported to CIF for incineration will come from on-site areas that generate, 1) solid low-level waste, 2) solid non-radioactive waste, 3) solid mixed waste, 4) liquid low-level waste, 5) liquid non-radioactive waste, 6) liquid mixed waste. Feed materials are assayed for the presence of several radioisotopes.

The incineration process yields two products, 1) ash, 2) off gas. The ash contains small amounts of radioactive isotopes, some heavy metals, and traces of uncombusted organic compounds. Composition of the off-gas may include: nitrogen (N_2), oxygen (O_2), carbon dioxide (CO_2), water (H_2O), hydrogen chloride (HCl), sulfur dioxide (SO_2), phosphorus pentoxide (PO_5), and ash particulate.

Handling and processing of waste materials in the CIF requires the highest degree of attention to prevent the contamination of personnel and the facility. The early identification of unusual conditions has high priority. Additionally, if the waste, solid or liquid, contains radionuclides, then the products of the CIF have the potential to be contaminated with radioactivity. Monitoring critical areas for airborne contamination allows identification and control of releases or spills.

In the current configuration, there are a total of sixteen (16) air monitors within the CIF that continuously monitor for the presence of airborne radioactivity. All of these instruments monitor radiation, from either a gaseous or particulate source. These monitors are referred to as Continuous Air Monitors, (CAMs).

One of the CAMs located at the CIF is a special radiation monitor called a Kanne Tritium Monitor. This Kanne Monitor is a more sophisticated, more sensitive, and more accurate radiation monitor which is designed to detect evidence of Tritium Gas.

Following a walk down of the system by Radiological Controls Organization, it was determined that several pipe bends and horizontal pipe runs did not meet standards required for sample piping. As a result, additional electrical outlets have been added for portable air monitoring equipment, and two existing outlets have been rewired to receive supply from the Uninterruptable Power Supply (UPS). These outlets will be used to supply portable monitors which will collect the samples of record, and can be used to sample during abnormal conditions.

An approved DCF (J-DCF-H-00867) will place three (3) CAMs in "Retrospective Mode", leave two (2) CAMs in service, and abandon the remaining CAMs in place. The CAMs to remain in service take air samples from the vicinity of the box lift and the ashcrete processing, which are considered to be in the areas at highest risk for airborne contamination. The sample lines to be placed in Retrospective Mode take samples from the vicinity of the kiln stairway, box pusher, and ashout enclosure. The CAMs are not required for regulatory monitoring of the air since portable air samples taken by Health Physics will be used as samples of record.

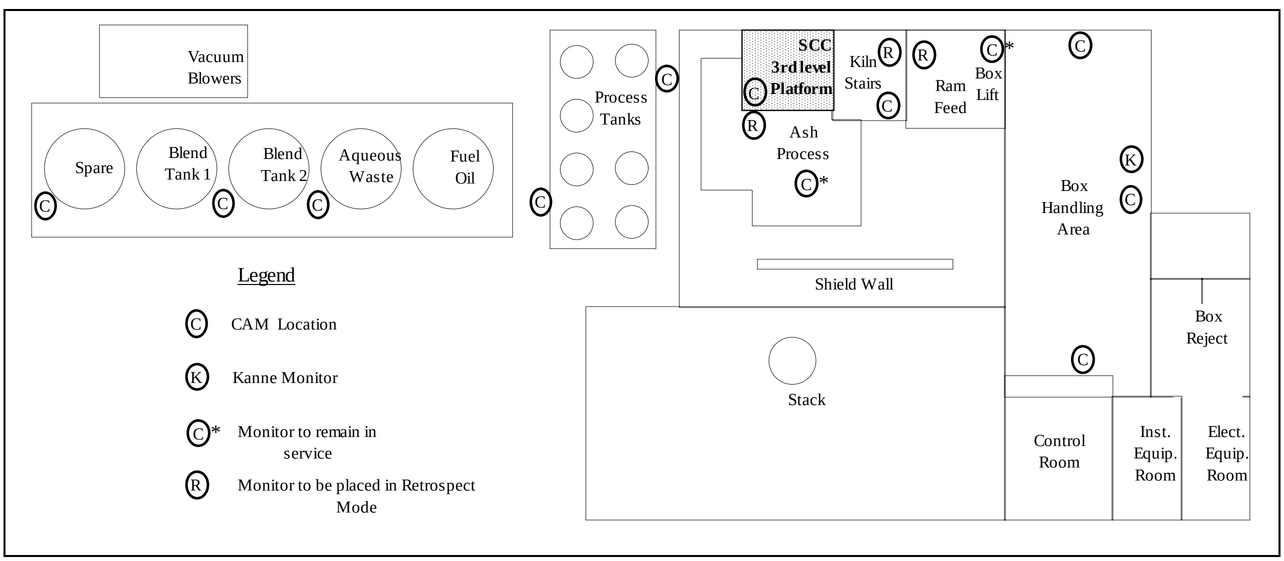


Figure 1 CAM Locations

The final configuration will maintain flow through filter papers in the abandoned collection chambers with the beta detectors tagged out of service. The Kanne chamber will remain isolated. The flow through these out of service chambers is necessary to maintain total airflow through the system due to the design capacities of the vacuum blowers. The filter papers will periodically require replacement to prevent dust from clogging the vacuum blowers. (See Figure 1, *CAM Locations*.)

CLI convention

Throughout this study guide, Component Location Identifiers (CLIs) are included to assist the reader with identification and labeling of the equipment described. Due to the number of components which are similar in labeling, CLIs in this document may include an “X” to represent several possible characters. Examples of this convention are:

- Ashout enclosure alarm annunciator (H-261-AM-ANN-6607-(D)) - contains no “X”, therefore it indicates a specific component identified by the indicated CLI. In this case, it is the audible horn at the local alarm panel for the ashout enclosure detector.
- Ashout enclosure alarm annunciator (H-261-AM-ANN-6607-(X)) - indicates equipment with like functions for a specific component. In this case, the “X” replaces a letter which could represent either of the local annunciators, i.e. the audible horn (H-261-AM-ANN-6607-(**D**)) or the flashing light (H-261-AM-ANN-6607-(**C**)).
- CIF building radiation element (H-261-AM-RE-66XX) - indicates any radiation element located in the CIF building. In this case, the “XX” replaces numbers which could represent several elements, i.e. (H-261-AM-RE-66**01**), (H-261-AM-RE-66**02**), (H-261-AM-RE-66**03**),..etc.
- Radiation element (H-26X-AM-RE-6XXX) - indicates any radiation element located at the facility. In this case, the “X” replaces a number in the building number and could indicate 261 or 262, and the “XXX” replaces numbers which could represent several elements, i.e. (H-26**1**-AM-RE-6**607**), (H-26**1**-AM-RE-6**604**), (H-26**2**-AM-RE-6**701**)..etc.

<u>Summary</u>

- The Air Monitoring System monitors for airborne particulate activity.
- The system is scheduled to be modified to:
  - Two CAM stations in normal service
  - Three stations changed to ‘Retrospective Mode’
  - Other CAM stations abandoned in place, but with flow though them
- Samples of record and samples for when the CAM stations are unavailable will be taken by RCO with portable sampling devices.
- Safety hazards present due to Air Monitoring system operation include noise, high temperature, rotating machinery, and high voltage.

SYSTEM PURPOSE

ELO 1.1	**STATE the purpose of the Air Monitoring System.**

System Purpose

The purpose of the Air Monitoring (AM) System for the CIF is to collect air samples from the process areas. These samples are used to determine beta activity levels and sound the proper alarms if the sample exceeds the high set-points. This process will provide identification of high airborne activity which could be the result of leaks or spills in the facility.

A secondary purpose of the Tank Farm CAM system is to provide a minimum flow in the Tank Farm Exhaust Stack. Without a minimum flow in the this stack, the Tank Farm Stack Air Activity Monitoring (SAAM) System isokinetic monitor will adjust its sample rate to zero, and potentially damage its vacuum blowers.

Review

- What is the purpose of the Air Monitoring System?

DESCRIPTION AND FLOWPATH

ELO 1.2	**DESCRIBE how the Air Monitoring System accomplishes it's intended purpose.**
ELO 2.1	**DESCRIBE the physical layout of the Air Monitoring System components including, the general location, how many there are, and functional relationship for each of the following major components:** **a. CIF Building Continuous Air Monitor Vacuum Blowers** **b. Tank Farm Continuous Air Monitor Vacuum Blowers** **c. Beta Monitors** **c. Kanne Monitor**

System Arrangement

There are four vacuum blowers used in the Continuous Air Monitoring System. Two are for the CIF building and two for the Tank Farm. The blowers provide air flow through the system detectors. In each case, one of the blowers is designated for primary operation and one blower for stand-by. The vacuum blowers in the CIF building are located on the third level, south of the Secondary Combustion Chamber and are designed to support twelve (12) beta radiation monitors and the Kanne Tritium Gas Monitor. The vacuum blowers in the Tank Farm are designed to support three (3) beta radiation monitors and are located on the concrete pad to the north of the Tank Farm. The monitors sound alarms on the Rad Monitor Panel (H-261-HM-PNL-2405) in the Control Room and on the individual area monitor panels for **HIGH RADIATION** and/or **MONITOR FAILURE**.

As stated previously, an approved DCF will place three (3) beta monitors in Retrospective Mode, maintain two (2) beta detectors in service, and abandon the remaining monitors in place by tagging the detector power supplies out of service. Flow through the beta monitors will continue to be drawn due to the rated flow required for the CAM vacuum blowers. The beta monitors placed in Retrospective Mode will have the detector removed from the sample chamber, and the resulting hole will be capped. The inlet piping will be fitted with a filter paper holder which will be periodically removed and analyzed.

Beta Monitors

Air flow in a CAM enters the chamber through the sample line. The chamber contains a filter paper placed flat over the outlet line leading from the bottom of the chamber. The beta detector is situated looking down over the filter paper. As flow exits the chamber, it passes through a flow meter and flow control valve and continues to the blower suction. (See Figure 2, *Beta Radiation Monitor*.) The flow control valve is adjusted to maintain a flow rate of 5.0 to 5.5 Standard Cubic Feet per Minute (SCFM) through the filter paper.

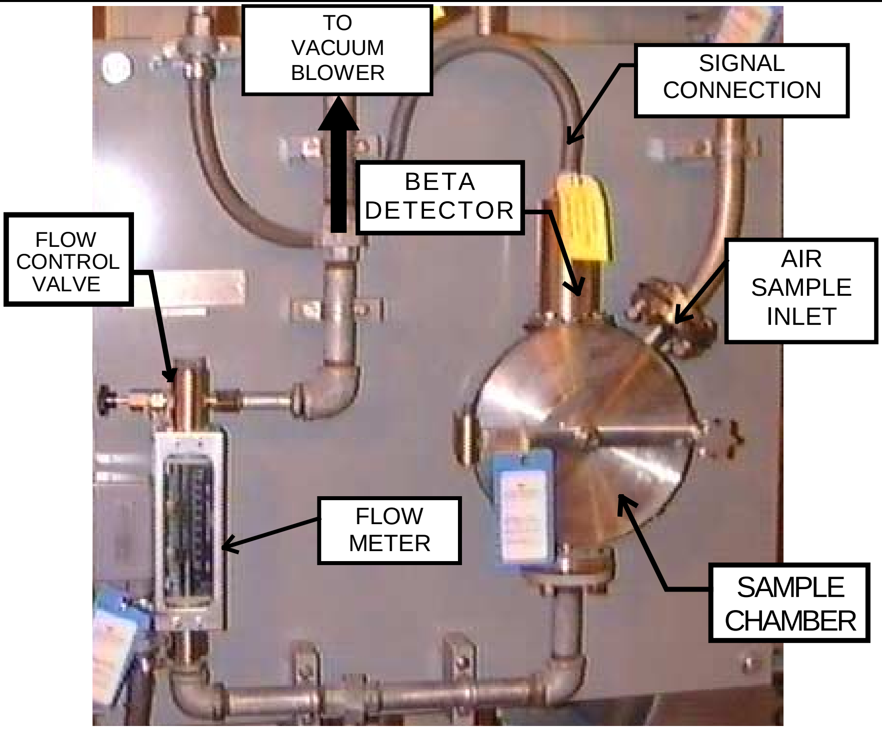


Figure 2 Beta Radiation Monitor

Kanne Monitor

The Kanne monitor is located in the Box Handling Area at the east wall. Air flow in the Kanne monitor enters through one of three (3) sample lines. The flow is designed to be controlled by three flow valves (H-261-AM-FV-6603-(A/B/C)) which cycle in series through sample locations at the assay station, the X-ray station, and the north wall of the Box Handling Area. The flow can be adjusted through the monitor by a flow control valve in the line before the detector, and would normally be set to maintain a flow rate of 5.0 to 5.5 SCFM. The Kanne monitor will not be placed in operation, and will be abandoned in place.

ELO 2.2	**DESCRIBE the Air Monitoring System arrangement for the CIF Building to include a drawing showing the following system components and interfaces with other systems:** **a. CIF Building Continuous Air Monitor Vacuum Blowers** **b. Silencers** **c. Filters** **d. Relief valves** **e. Pressure gauges** **f. D/P detectors and switches** **g. Temperature switches** **h. Interface with Main Exhaust System**

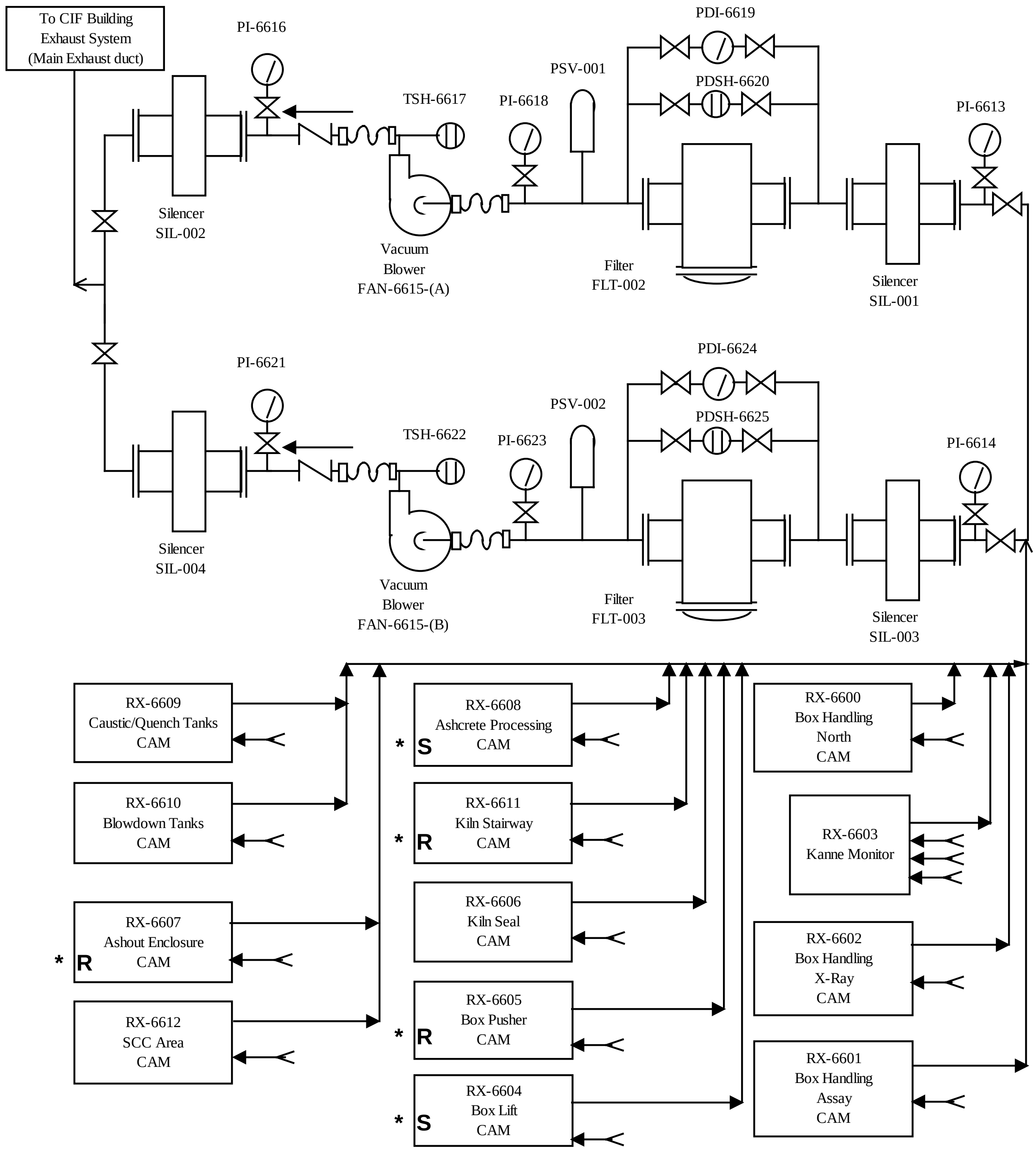
System Flow-path

Flow-path of CIF Building Beta Monitor Air

The air samples for beta monitoring in the CIF Building are designed to be taken from twelve (12) locations in the various operating areas of the main CIF Building. These samples are pulled from approximately six (6) feet above the floor level and processed through the respective beta monitor for evaluation of airborne beta radiation. The air flow continues through the inlet silencer, fan filter, the vacuum blower, the outlet silencer, and is exhausted into the HVAC duct before the HEPA filters. (See Figure 3, *CIF Building Continuous Air Monitors*.)

Flow-path of CIF Building Tritium Gas Monitor Air

The Tritium gas air samples are designed to be taken from the North end, x-ray area, and Assay area, within the Box Handling Area of the CIF building. These samples would be pulled from approximately six (6) feet above the floor level and processed through the Kanne Monitor for evaluation of tritium gas. From the Kanne Monitor the air flow would continue through the inlet silencer, fan filter, the vacuum blower, the outlet silencer, and exhaust into the HVAC duct before the HEPA filters.



*R - Cams to be placed in Retrospective Mode

*S - Cams to remain in normal (as designed) service

Figure 3 CIF Building Continuous Air Monitors

ELO 2.3	**DESCRIBE the Air Monitoring System arrangement for the Tank Farm to include a drawing showing the following system components and interfaces with other systems:** **a. Tank Farm Continuous Air Monitor Vacuum Blowers** **b. Silencers** **c. Filters** **d. Relief valves** **e. Pressure gauges** **f. D/P detectors and switches** **g. Temperature switches** **h. Interface with Tank Farm exhaust stack**

Flow-path of Tank Farm Sample Air

The air samples for beta monitoring in the Tank Farm are designed to be taken from locations beside the Aqueous Waste Tank, Blend Tanks, and Spare Tank approximately eight (8) feet above floor level in the Tank Farm. The air flow continues through the monitor chambers which will have filter papers in place but no power to the detectors. The flow then continues through the inlet silencer, fan filter, the vacuum blower, the outlet silencer, and is exhausted to the Tank Farm Exhaust Stack atmosphere above the Spare Tank. (See Figure 4, *Tank Farm Continuous Air Monitor Vacuum Blowers*.)

The air flow is provided by the Tank Farm CAM vacuum blower in operation. Flow rate through each monitor chamber is regulated by the flow control valve at the outlet of the flow meter.

<u>Review</u>

- Which CAM Stations will be modified to the Retrospective Mode?
- Which CAMs will remain in their designed operational mode?
- Why are the Tank Farm CAMs required to remain in place with normal flow through them?

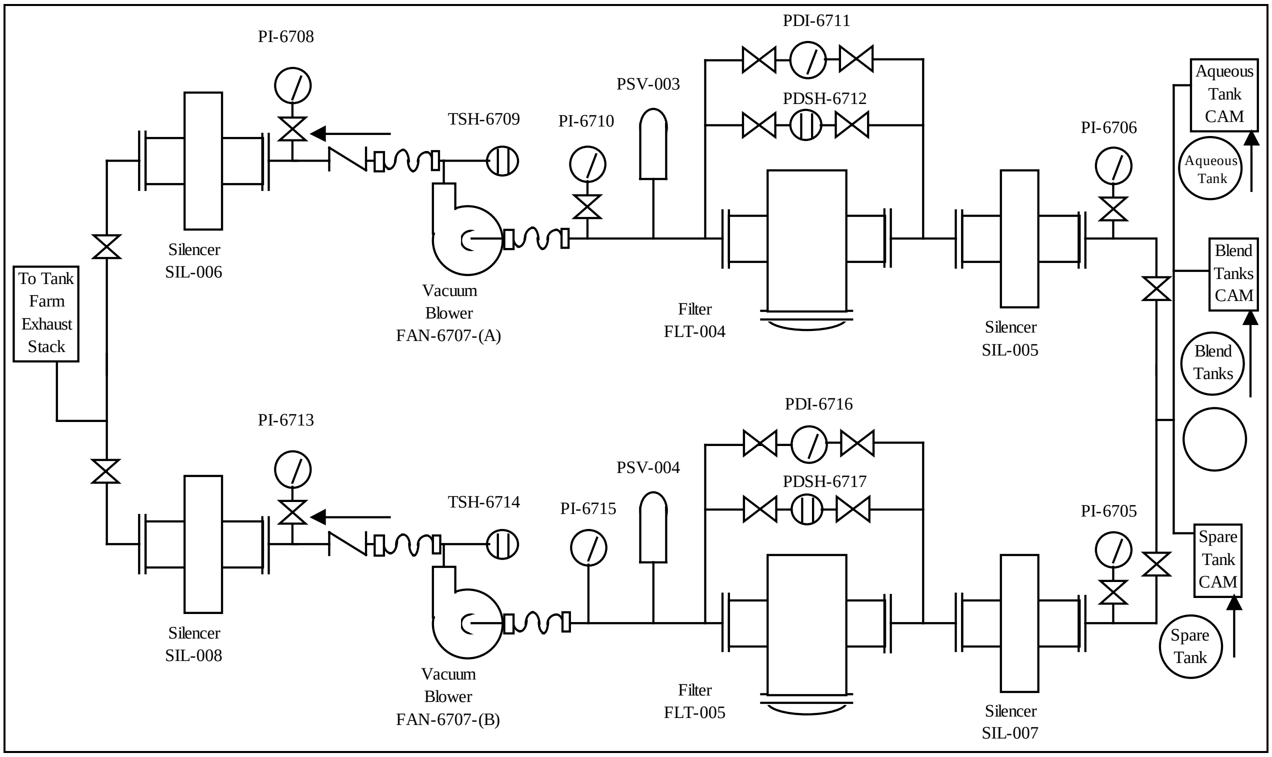


Figure 4 Tank Farm Continuous Air Monitor Vacuum Blowers

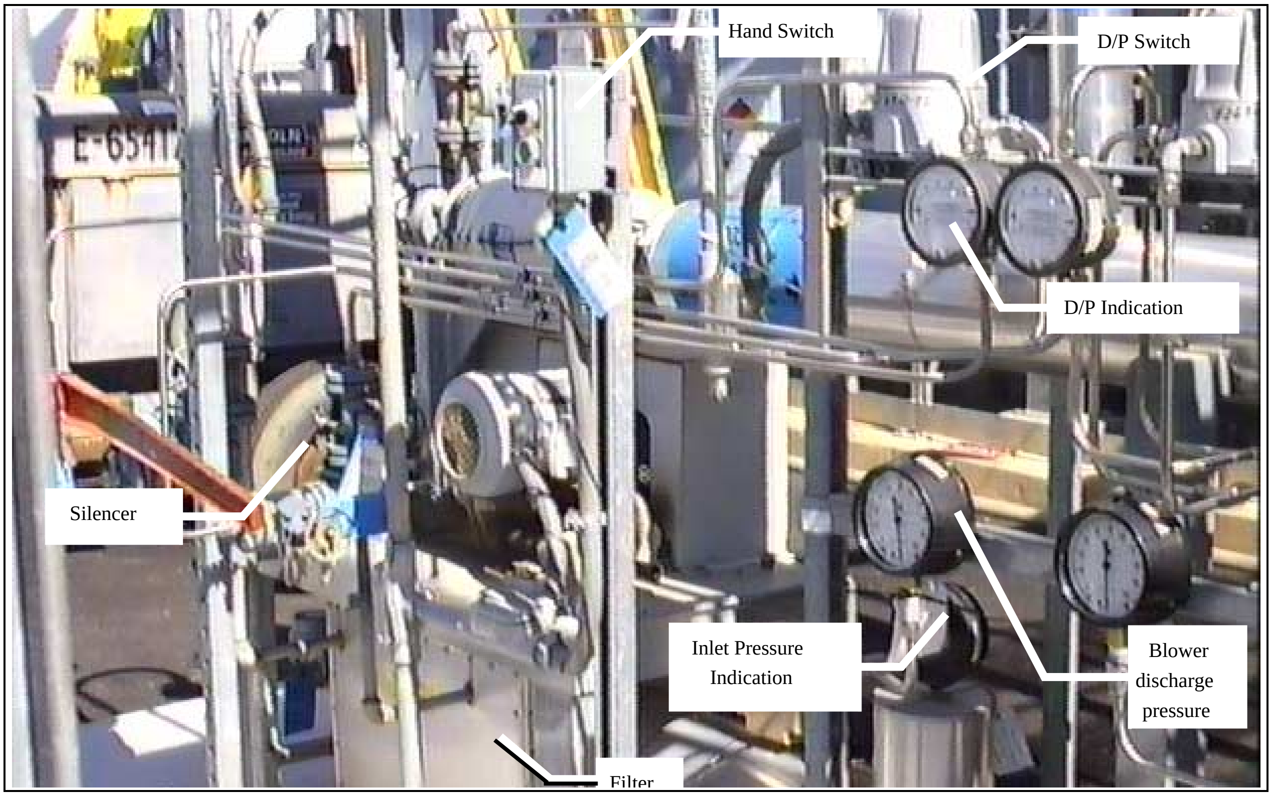


Figure 5 Tank Farm Vacuum Blower and Associated Instrumentation

MAJOR COMPONENTS

ELO 3.1	**DESCRIBE the following major components of the Air Monitoring System including their functions, principles of operation, power supplies, and basic construction:** **a. Vacuum blowers** **b. Beta Detectors** **c. Kanne Tritium Radiation Monitor** **d. Count rate meters** **e. Local alarm panels**

Continuous Air Monitor Vacuum Blowers (CIF Building)

In the CIF building there are two (2) Continuous Air Monitor (CAM) vacuum blowers which are manufactured by Sutorbilt. These blowers provide air flow from the areas to be monitored, through the beta monitors and Tritium monitor, and exhaust to the HVAC duct. These vacuum blowers are located on the third level, south of the Secondary Combustion Chamber. The exhaust pipe is connected to the HVAC duct overhead and east of the vacuum blower location.

The vacuum blowers are axial flow fans which are belt driven by a motor assembly. The motors for fans A and B (H-261-AM-FAN-6615-(A) and H-261-AM-FAN-6615-(B)) are powered by MCC 7 and 8 respectively. The vacuum is provided by pulling the air from the suction piping of the blowers. The CIF Building CAM vacuum blowers are of sufficient size to support flow through twelve (12) beta monitors and the Kanne monitor.

Continuous Air Monitor Vacuum Blowers (Tank Farm)

In the Tank farm there are two (2) CAM vacuum blowers which are manufactured by Roots. These blowers provide air flow from the Tank Farm beta monitors to the exhaust stack, and to the atmosphere above the Spare Storage Tank. The Tank Farm vacuum blowers are located on the concrete pad to the north of the Tank Farm.

The vacuum blowers are axial flow fans which are belt driven by a motor. Fans #1 and #2 (H-262-AM-FAN-6707-(A) and H-262-AM-FAN-6707-(B)) are powered by MCC 7 and 8 respectively. The vacuum is provided by pulling the air from the suction piping of the blowers. The Tank Farm CAM vacuum blowers are smaller than the CIF Building CAM blowers since they need only to support flow through three (3) beta monitors.

Beta Detectors

There are fifteen (15) CAM beta detector sampling stations which are manufactured by Val-Tech, Inc. These stations contain radiation elements, filter paper holders, flow meters, and flow control valves (Figure 2).

The radiation elements (H-26X-AM-RE-6XXX) in the beta detectors are Geiger-M①eller (G-M) gas-filled detectors which can detect both beta and gamma radiation. G-M detectors are used because of their high sensitivity to low level beta particles.

A signal in the detector is developed when a radioactive particle passes through the detector and interacts with the gas inside the detector. The interaction causes the gas to become ionized which allows current to flow through the detector. In a G-M type detector, the voltage between the anode and cathode is high enough such that a single interaction causes the entire detector to become ionized. Each interaction, however brief, causes a large current flow, which is why the detector is so sensitive. (Sensitivity, the ability to detect a small interaction, should not be confused with accuracy, the ability to discriminate between different numbers of small interactions.) The beta detectors develop and send these signals to their respective radiation transmitters (H-26X-AM-RIT-6XXX) located in the Rad Monitoring Panel (H-261-HM-PNL-001) in the Control Room.

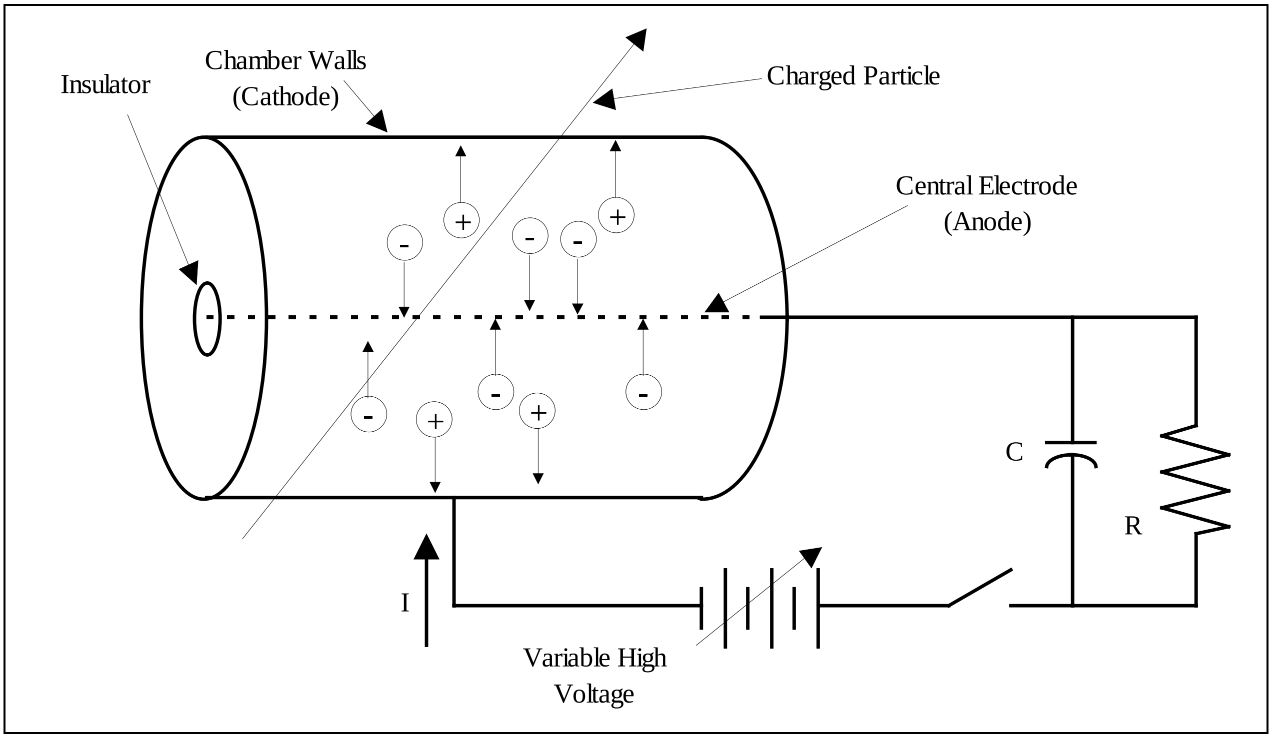


Figure 6 Gas Filled Detector

Flow past the beta detectors is controlled by the air passing through a combination flow meter and flow control valve assembly. The flow control valve is a manually adjustable throttle valve. The flow meter is a float type instrument which operates on the principle of variable area for flow. A low flow condition can be detected through the use of an adjustable reed switch mounted on the flow meter. The explanations of these measuring devices are covered further in the Instrumentation chapter.

Kanne Tritium Radiation Monitor

There is one (1) Kanne tritium gas chamber sampling station which is manufactured by Equipment Design & Fabrication, Inc. This station has the ability to detect Tritium Gas Radiation, and send alarms to the DCS and local alarm panels.

The Kanne Sampling Station consists of a Tritium Gas Radiation Detector, 3 sample flow valves, 3 solenoid valves, a filter, flow switch, and a vacuum regulating valve. The Kanne chamber sample station is designed to take air samples for the detection of tritium gas from three locations in Box Handling Area:

- Box Handling North Wall Area
- Box Handling X-Ray Area
- Box Handling Assay Area

The Kanne Ionization chamber has a sample station and local alarm panel located next to the east wall of the Box Handling Area, near the exit to the truck dock. The DCS is configured to control the Kanne sample flow valves located in the Kanne Chamber sample station. The valves are cycled automatically until stopped by an interlock from the tritium gas high radiation switch. Each 3-way flow valve is controlled in a close-before-open operational sequence. If a "High Tritium Gas Radiation" signal is received, the DCS interlocks the valves. The interlock causes the sample flow valve currently open to remain open and the DCS alarm alerts the Control Room Operator of a high radiation from that sample. Air sampling will continue from this valve until the tritium gas level drops below the high set-point.

Count Rate Meters

The radiation transmitters (H-26X-AM-RIT-6XXX) are count rate meters which analyze the signal from the beta detectors and output indication and alarm signals. The indication of radiation level is displayed on the front of the count rate meters as a digital value. Indication signaling is also provided to the Distributed Control System (DCS). High radiation alarm signals are developed by the count rate meter and activate alarms at the Rad Monitor Panel, DCS, and local alarm panels (H-26X-AM-PNL-6XXX). Monitor failure alarms are activated at the Rad Monitoring Panel and DCS. Further explanation of the signals and indication for these transmitters is discussed in the Instrumentation chapter.

Local Alarm Panels

The count rate meters for the Air Monitoring System provide alarm signals which annunciate at the Rad Monitoring Panel, the DCS, and individual local alarm panels (H-26X-AM-PNL-6XXX). Each detector has its own associated panel. These panels are generally situated in the vicinity of the sample location for their detector. Each local alarm panel has a red flashing light (H-26X-AM-PNL-6XXX-(C)) and horn (H-26X-AM-PNL-6XXX-(D)) to indicated the presence of a high airborne condition. Each panel is equipped with an acknowledge push-button (H-26X-AM-HS-6XXX-(A)) and test push-button panels (H-26X-AM-PNL-6XXX-(B)). They are powered from power panels B, C and D. Generally, the alarm panels are powered from the distribution panel which is physically closest.

Following implementation of J-DCF-H-00867, most of these alarm panels will be abandoned in place with no power applied. In order to accomplish the deenergization, several of the power supplies to the alarm panel may need to be rewired.

Review

- From where are the local alarm panels powered?
- What type of detector is used for the Air Monitoring System? Why is this type used?
- What is the planned disposition of the Kanne Monitor?
- Where do high radiation alarms from the count rate meters sound or display?

INSTRUMENTATION

ELO 3.2	**Given values for key performance indicators, DETERMINE if Air Monitoring System components are functioning as expected.**
ELO 3.3	**DESCRIBE the following Air Monitoring System instrumentation including, indicator location, (local or Control Room) sensing points, and associated instrument controls.** **a. Pressure gauges** **b. D/P switches** **c. Temperature switches** **d. Flow meters** **e. Count rate meters**

Pressure Gauges

There are twelve (12) pressure gauges and four (4) differential pressure gauges in the Air Monitoring System. All the pressure gauges are local indication gauges only. Each pressure gauge has an associated isolation valve which allows for testing or maintenance of the gauge. Each differential pressure gauge has inlet and outlet isolation valves which allows for testing or maintenance of the gauge Each vacuum blower has three (3) pressure gauges and one (1) differential pressure gauge:

- Vacuum blower unit filter inlet pressure gauge, located on the air inlet side of the filter on each of the four vacuum blowers, measure pressure before the filter. These gauges read on a scale of 0 to 20 inHg vacuum for the CIF Building and 0 to 10 inHg vacuum for the Tank Farm.
- Vacuum blower inlet pressure gauge, located on the inlet side of the blower and after the filter, measures pressure on the inlet side of the vacuum blower. These gauges read on a scale of 0 to 15 inwc vacuum for the CIF Building and 0 to 15 inHg vacuum for the Tank Farm.
- Vacuum blower outlet pressure gauge, located on the outlet side of the vacuum blower before the outlet silencer, measures pressure on the discharge side of the vacuum blower. These gauges read on a scale of 0 to 200 inwc for the CIF Building and 0 to 100 inwc for the Tank Farm.
- Differential pressure gauge, located on each of the four vacuum blower filters, measures differential pressure across the vacuum blower filters. These gauges read on a scale of 0 to 10 inwc differential for the CIF Building and 0 to 1 inwc differential for the Tank Farm.

Differential Pressure Switches

Four (4) differential pressure switches are located in the Air Monitoring System. Each vacuum blower filter has a differential pressure switch, which has its own inlet and outlet isolation valves. If the differential pressure across a filter exceeds the specified limits of 5.4 inwc for the CIF Building or 0.6 inwc for the Tank Farm, contact is made inside the switch, and a signal is sent to the Rad Monitor Panel and an the DCS.

Temperature switches

Each vacuum blower has an associated temperature switch. These switches sense the temperature at the outlet of the vacuum blowers and will send signals to the Rad Monitoring Panel and to the DCS indicating a high temperature condition. The high temperature alarm for the vacuum blowers is set to alarm at 275 °F.

Flow meters

The flow meter used for the CAM stations is a variable area float type direct reading meter. A metal float within a tapered glass tube is free to travel up and down the tube. The force of gravity acts to keep the float at the bottom of the tube. As fluid or gas passes through the tube, flow forces the metal float up. As the float rises, the fluid has a greater area to flow around the float, and the force acting upward decreases proportionally with the height of the float. When the forces exerted by gravity and flow are equal, the float will remain stationary. The height of the float can then be used to read the flow through the tube. (See Figure 7, *Variable Area Flow Meter*.)

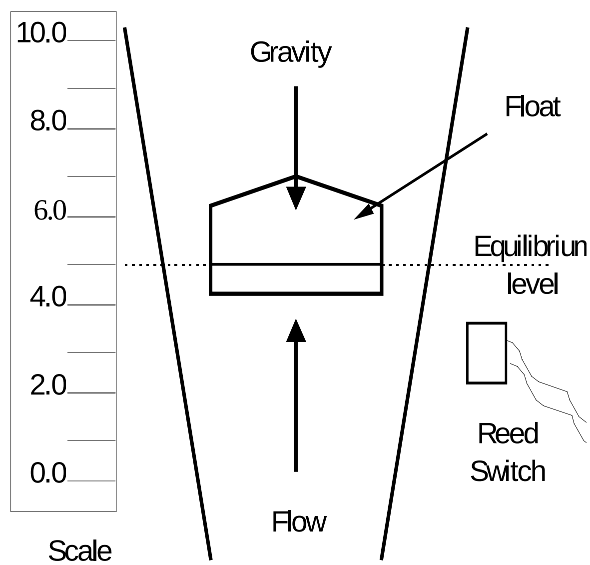


Figure 7 Variable Area Flow Meter

The flow meters are equipped with magnetic reed switches. These switches are magnetically actuated. When a metallic object, such as the float, passes close to the switch, a magnetic field is created with enough force to close electronic contacts in the switch. The closing or opening of the contact can be used to signal alarms or position indicators.

Count rate meters

Count rate meters (Figure 8), supplied by Val-Tech, and located on the Rad Monitoring Panel, indicate the radiation level at each monitor. Each count rate meter operates in conjunction with a beta detector located in the CIF Building or the Tank Farm. The detector senses the beta emissions from contaminated particles collected on the filter in the monitor chamber. Each interaction signals the count rate meter as an electrical pulse. The digital display on the count rate meter indicates the level of radioactivity detected in the monitor chamber.

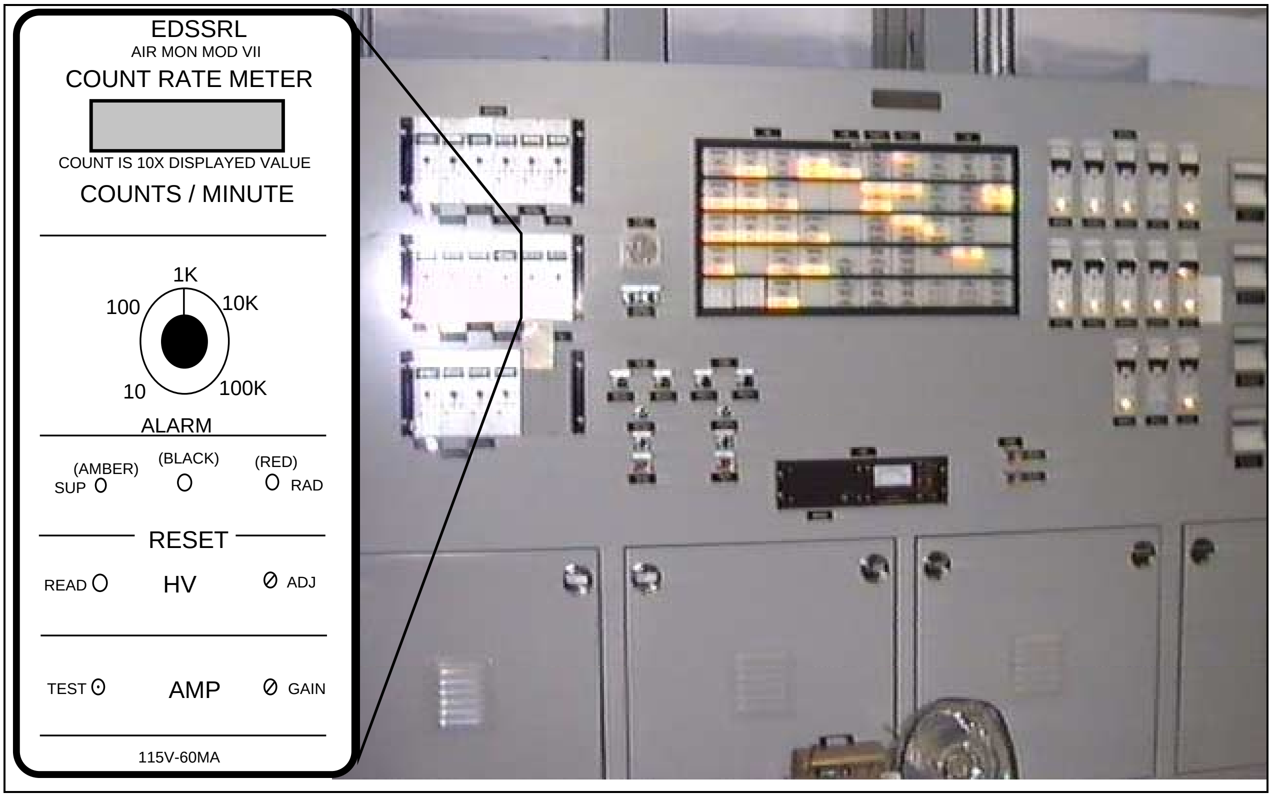


Figure 8 Val-Tech Count Rate Meter

If the count rate exceeds the high set-point, the red "RAD" LED will illuminate, and alarms will sound in the control room and at the local panel, the rotating beacon will illuminate at the local panel, and the DCS will receive a signal indicating the high radiation condition. The actual count rate is indicated on the Liquid Crystal Display (LCD), and is available to DCS for analysis and recording. The LCD indicates count rates multiplied by factors of 10 which are selected by depressing and rotating the "ALARM" knob.

The amber "SUP" (Supervisory Alarm) LED illuminates when meter internal operating parameters are lost or exceeded. Maintenance is required when this LED illuminates.

The black "RESET" push-button is depressed to silence the "RAD" and/or the "SUP" alarms after the cause of the alarm is verified and corrected.

The "HV" (High Voltage) "ADJ" and "READ" section, and the "AMP (Amplifier) "GAIN" and "TEST" sections are used by Maintenance for adjustment and calibration.

<u>Review</u>

- Which instruments have associated alarms? From where do they sense?

CONTROLS, INTERLOCKS AND ALARMS

ELO 3.5	**EXPLAIN how the following Air Monitoring System equipment is controlled in all operating modes or conditions to include: control locations (local or Control Room), basic operating principles of control devices, and the effects of each control on the component operation.** **a. CIF Building Continuous Air Monitor Vacuum Blowers** **b. Tank Farm Continuous Air Monitor Vacuum Blowers**

Controls

The Control Room Operator can monitor the Air Monitoring System from the DCS, however, no control functions are provided by DCS. The Kanne sample valve control (see interlocks below) was controlled by the DCS, but since the Kanne will not be in service, this control function is not applicable.

Normal controls for the Air Monitoring System are located on the Rad Monitor Panel (H-261-HM-PNL-2405). This panel in the control room contains high radiation alarms for the beta monitors, high radiation alarms for the Tritium Monitor, and CAM Count Rate Meters (counts per minute) which relate to the Continuous Air Monitors. The vacuum pumps are normally controlled from the Rad Monitoring Panel by positioning the selector switch for the pump and depressing the start push-button for the pump to be in operation. Stopping either or both of the pumps is accomplished by depressing the stop push-button. To switch operating pumps, the selector switch is repositioned to the pump to be started, and timed relays within the pump control circuitry will automatically start the standby pump and stop the previously running pump.

In order for the remote controls to be operable, the local Manual/Off/Auto (MOA) control switch at the pump must be in AUTO. Figure 9, *CAM Vacuum Blower Control Circuitry* shows the arrangement and CLI numbers for the CIF Building Continuous Air Monitor Vacuum Blower (A) controller circuitry. If the local MOA switch (H-261-HS-6615-(AA)) is in MAN, starting and stopping of the pump can only be accomplished at the local hand switch. If the switch is in AUTO, control of the blower is maintained by R-110 (H-261-QY-6615-(AE)), which if energized, closes and completes the circuitry to the M-coil. Local starting of the pump energizes the local start relay, R-16 (H-261-QY-6615-(AA)) in the panel. The contact R-16 will close when the relay is energized by depressing the local push button. Current will then flow through the R-19 contact which will be closed if the selector switch is positioned to No. 1. R-36 will energize, R-37 will energize, and current will flow through the R-37 and R-18 contacts, which in turn will energize R110. The other local controllers are similar in arrangement.

It should be noted that the fans, motors, and circuitry is differentiated as either ‘A’ or ‘B’, but the two position switch is labeled ‘No. 1’ and ‘No. 2’. The No. 1 position is for Fan ‘A’ and the No. 2 position is for Fan ‘B’. Also in Figure 11, it should be noted that both the “STOP’ and ‘START’ push buttons are labeled H-261-AM-HS-6615-(B). This is possibly due to the construction of the buttons which could be one unit, and the individual parts are not given different CLIs.

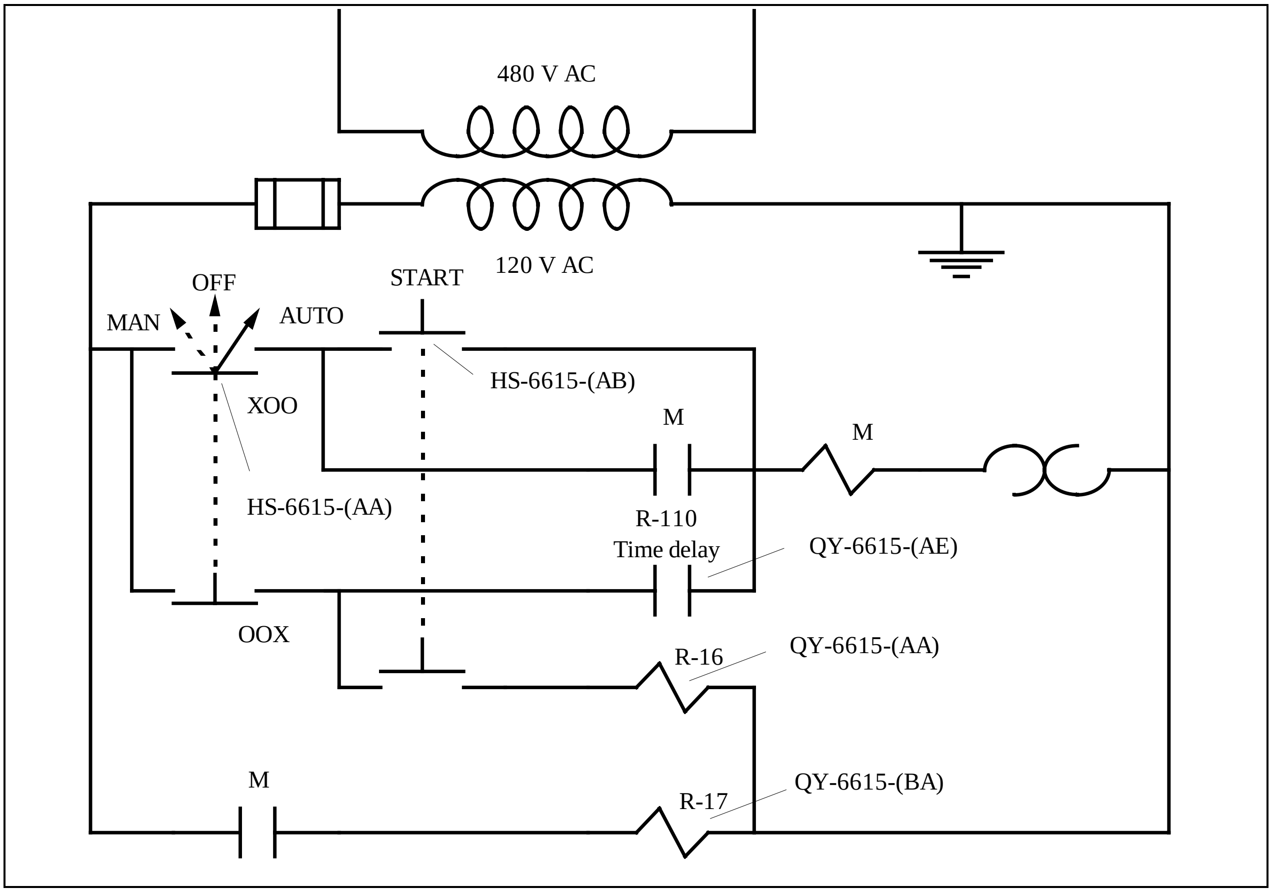


Figure 9 CAM Vacuum Blower Control Circuitry (Simplified)

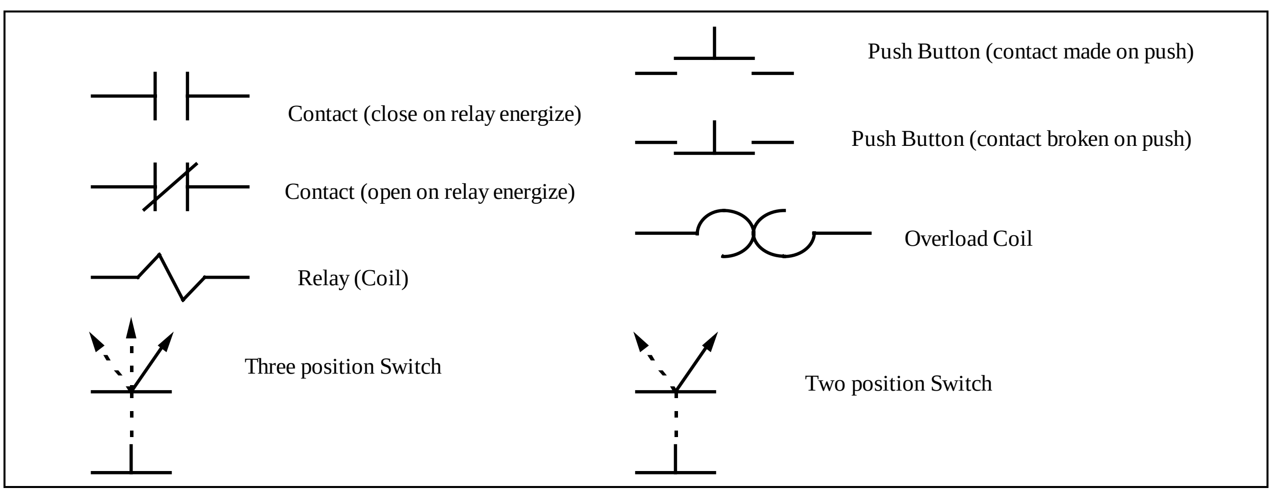


Figure 10 Symbols for Schematics

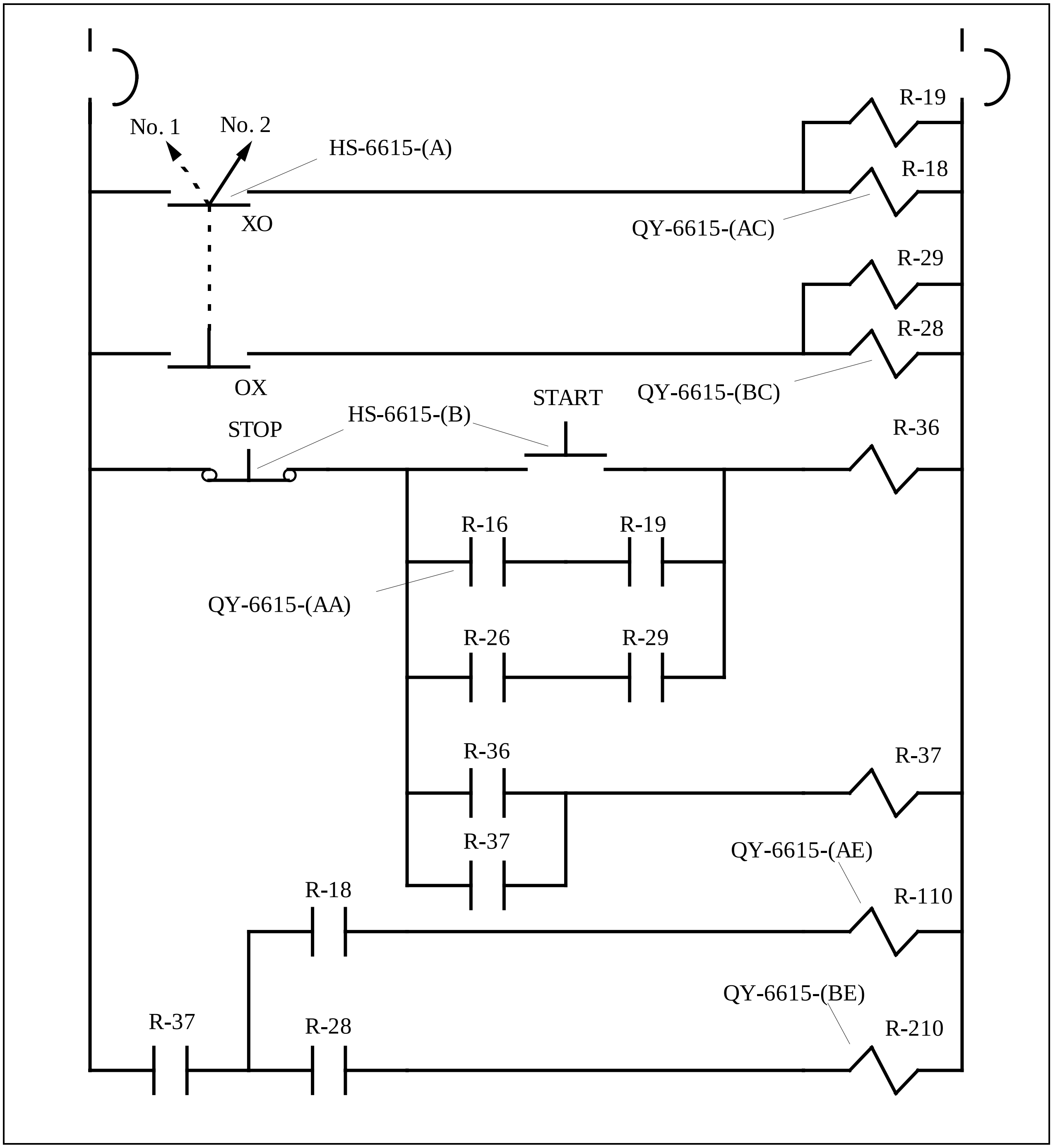


Figure 11 CAM Vacuum Blower Selector Circuitry (Simplified)

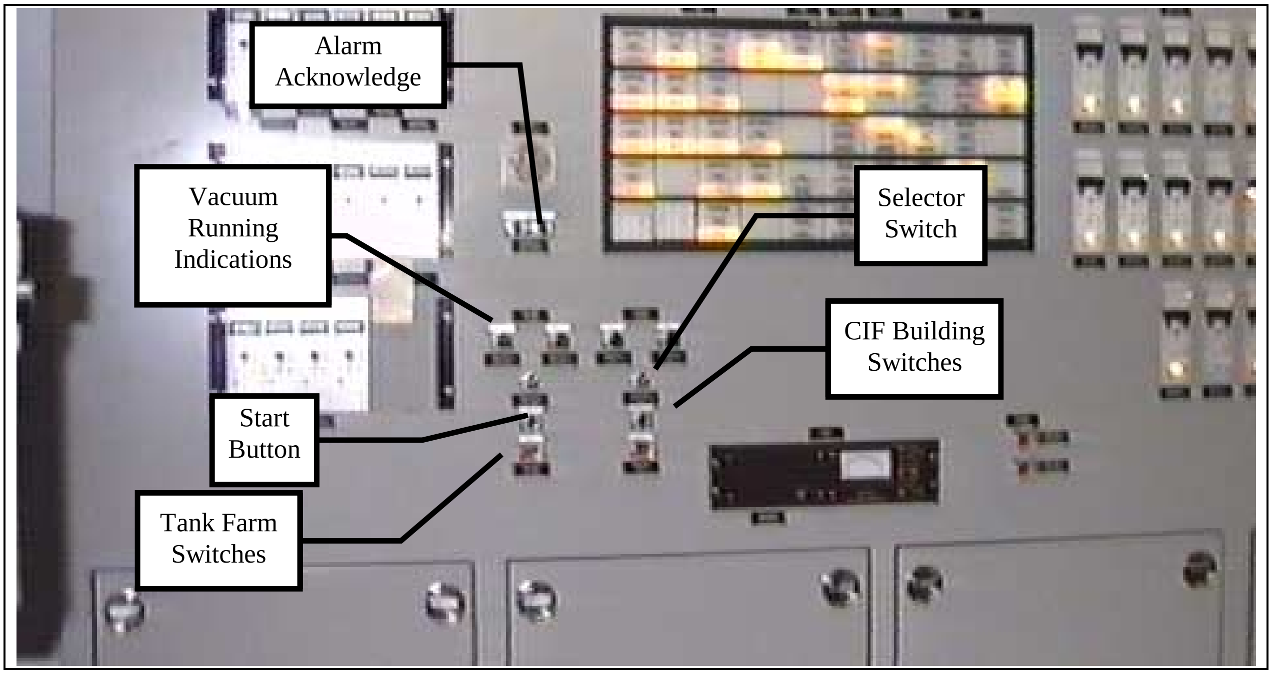


Figure 12 Remote CAM Vacuum Blower Switches

Interlocks

The only interlocks within the Air Monitoring System are the hard-wired control functions associated with the pump motor controllers. No logic interlocks are controlled by the DCS.

A previous interlock was associated with the Kanne Chamber. The DCS controlled the position of the solenoid valves to select air samples from the Box Handling Assay, Box Handling North Wall, and Box Handling X-Ray areas within the Box Handling Area. The positions of the solenoid valves was programmed to a routine which changed the area being sampled. If the high set-point is reached, then the solenoid valve is interlocked on the area where the air sample was collected until the air sample recedes below the high set-point.

ELO 3.4	**INTERPRET the following Air Monitoring System alarms, including the conditions causing alarm actuation and the basis for the alarms:** **a. Radiation alarm** **b. High CAM vacuum temperature** **c. High differential pressure** **d. Low Flow** **e. Monitor Failure**

Alarms

Alarms associated with the Air Monitoring system are high beta radiation, high Tritium radiation, low air flow at the monitoring stations, high filter differential pressure, and high vacuum blower outlet air temperature.

Radiation Alarms

Radiation Alarms could be the result of high airborne activity levels, or could result from high gamma radiation in the vicinity of the detector. An additional reason for an alarm could be a malfunctioning detector. Until proven otherwise, all alarms should be treated as the condition for which they are alarming.

High CAM vacuum temperature

High temperature is measured at the outlet of the vacuum blowers. The switch will actuate based upon the temperature of the air, which could have been heated by the blower, or by a process prior to sampling. Most likely, the cause of a high temperature will be a malfunctioning blower, or a blower with inadequate flow. Upon receipt of this alarm, the operator should switch blowers.

Low Air Flow

Low air flow alarms are the result of inadequate flow through the flow meter assembly of a CAM station. The low flow condition could be due to a problem associated with the individual CAM station, or it could be the result of blower malfunction. If a blower is the problem resulting in inadequate flow for a CAM station, there will associated problems at the other stations served by that blower. A possible cause of an alarm when the low flow condition does not exist is magnetic interference in the vicinity of the low flow reed switch.

High Differential Pressure

High differential pressure can be indicated by the differential pressure indicator or the differential pressure switch which sense pressures at the inlet and outlet of the filters. A high differential pressure condition should cause the switch to send a signal indicating the condition on the Rad Monitoring Panel and DCS. The high differential condition may also be read locally at the filter. A high differential pressure condition would be caused by excessive flow rate, which is unlikely, or by filter clogging. Upon receipt of a high differential pressure alarm, the standby blower should be started, and the filter which had the high differential condition will need to be cleaned.

Monitor Failure

A monitor failure signal is developed when a count rate meter fails to provide a minimum output signal. The normal output of the meter is a 4-20 milliampere signal. If the minimum signal is lost, circuitry inside the Rad Monitoring Panel detects the loss and displays a Monitor Failure Alarm. The Rad Monitoring Panel also sends a complimentary signal to DCS to also inform it of the loss of the meter. The Monitor Failure alarm does not cause any alarm functions at the local alarm panel.

(EN) Drawing Designation	CLI	Name
*A	H-26X-AM-ANN-6XXX-(D)	Audible Horn
*B	H-26X-AM-RX-6XXX	CAM Sampling Station
*B-1	H-26X-AM-PNL-6XXX	Local Alarm Panel
*FS	H-26X-AM-FISL-6XXX-(A)	Low Flow Switch
*FA	H-26X-AM-FAL-6XXX-(B)	Low Flow Alarm (2405)
*FA-1	H-26X-AM-FAL-6XXX-(A)	Low Flow Alarm (DCS)
*PB-1	H-26X-AM-HS-6XXX-(A)	Acknowledge Push-Button
*PB-2	H-26X-AM-HS-6XXX-(B)	Test Push-Button
*RSH	H-26X-AM-RSH-6XXX	High Radiation Switch
*X	H-26X-AM-RE-6XXX	Radiation Detector
*XA	H-26X-AM-ANN-6XXX-(C)	Flashing Light
*XA-1	H-26X-AM-RAH-6XXX-(B)	High Radiation Alarm ()
*XA-2	H-26X-AM-RAH-6XXX-(A)	High Radiation Alarm (DCS)
*XA-3	H-26X-AM-YA-6XXX-(B)	Monitor Failure Alarm (2405)
*XA-4	H-26X-AM-YA-6XXX-(A)	Monitor Failure Alarm (DCS)
*XA-5	H-26X-AM-RAH-6XXX-(E)	Local Alarm Light
*XG	H-26X-AM-RI-6XXX	DCS Radiation Indication
*XT	H-26X-AM-RIT-6XXX	Count Rate Meter
*YS	H-26X-AM-YS-6XXX	Monitor Failure Switch

Table 1 W841033 Designations

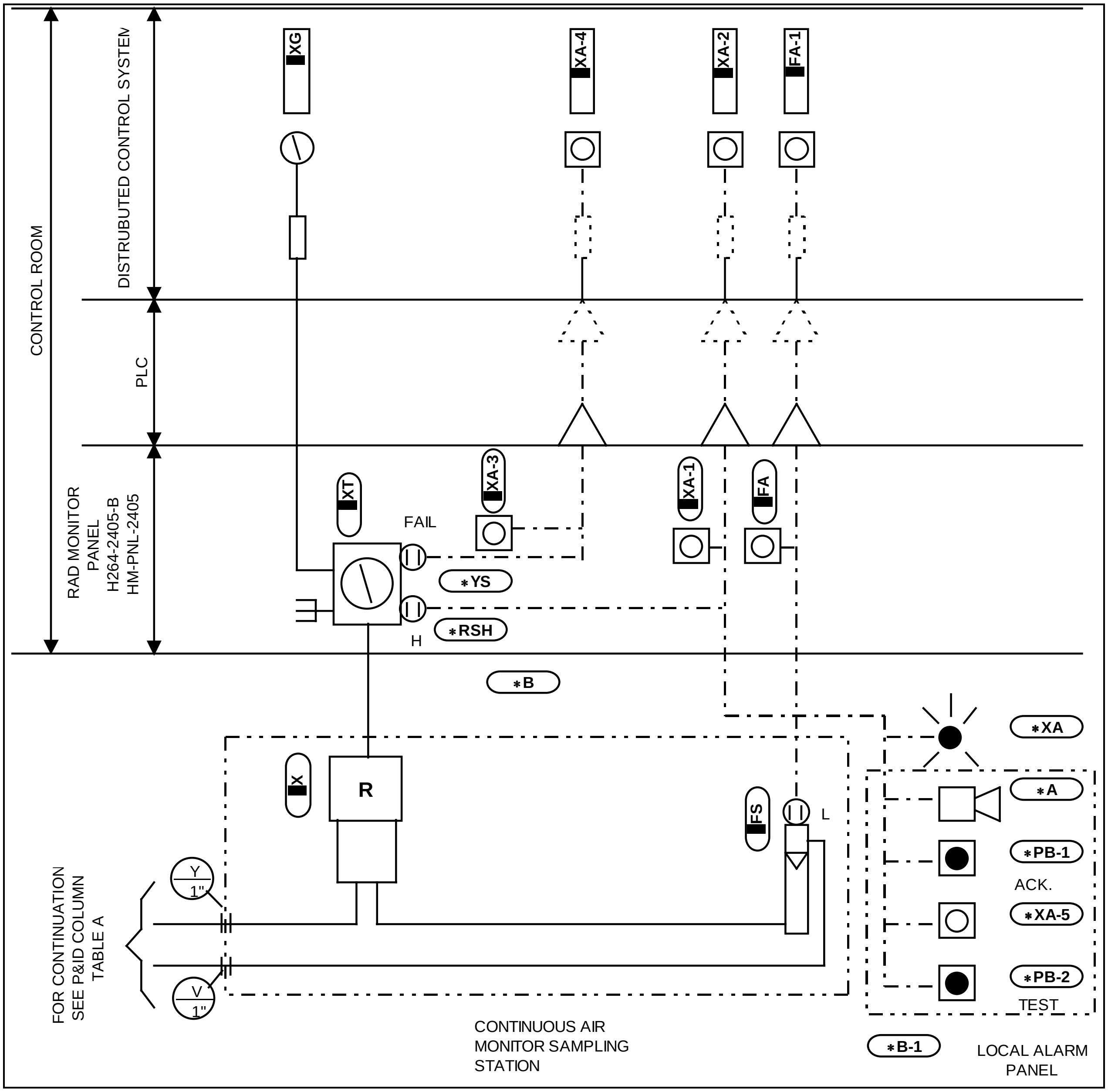


Figure 13 Excerpt From W841033

The preset limits for activating alarms are as follows:

Condition	CLIs	Setpoint (Note 1)
Maximum radiation count	H-26X-AM-RAH-6XXX	10% over background (TBD by RCO)
Minimum air flow for each CAM	H-26X-AM-FA-6XXX	3.0 SCFM
CIF Building Vacuum Blowers Filter D/P	H-261-AM-PSH-6620 H-261-AM-PSH-6625	5.6 inwc
Tank Farm Vacuum Blowers Filter D/P	H-262-AM-PSH-6712 H-262-AM-PSH-6717	0.6 inwc
Vacuum Blower outlet temperature	H-261-AM-TSH-6617 H-261-AM-TSH-6622 H-262-AM-TSH-6709 H-262-AM-TSH-6714	275 °F

Table 2 Air Monitoring System Alarm Setpoints

Note 1: Setpoints are based upon Setpoint Document (J-JX-H-0020) Rev. 3 dated 3/11/96.

<u>Review</u>

- What interlock or control features are associated with the vacuum blowers?
- What other interlocks exist in the Air Monitoring System?
- What alarms are associated with the count rate meters? What conditions cause these alarms to sound?
- Which alarms sound on the Rad Monitoring Panel? Which alarms sound on Local Alarm Panel? Which alarms sound on DCS?

SYSTEM INTERRELATIONS

Distributed Control System

The Air Monitoring System interfaces with the Distributed Control System (DCS) through the Rad Monitoring Panel. Alarm signals received in the Rad Monitoring Panel activate complimentary relays which activate PLC relays. The PLC relays are used to signal Point Tag Displays in the DCS. The DCS receives the following alarms and indications in this manner::

- The DCS receives signals from the count rate meters for high beta radiation and monitor failure.
- The DCS receives signals from the Kanne Tritium detector for high Tritium radiation.
- The DCS receives signals from the low flow switches indicating low flow through a CAM station.
- The DCS receives signals from the differential pressure switches for high differential pressure across the vacuum blower inlet filters..
- The DCS receives signals from high temperature switches for high temperature at the vacuum blower outlets.

The DCS is configured to control the Kanne sample flow valves. Since the Kanne monitor will be abandoned in place, this control may eventually be eliminated.

Heating, Ventilation and Air Conditioning System

The Air Monitoring System interfaces with the Heating, Ventilation and Air Conditioning System (HVAC) at the CIF Building CAM vacuum blowers exhaust. The vacuum blower exhausts the air into the Main Exhaust System duct. This connection is located in the main duct before the HEPA filters.

Area Radiation Monitoring System

The Air Monitoring System interfaces with the Area Radiation Monitoring (HM) System at the Rad Monitoring Panel. The Rad Monitoring Panel is considered part of the HM System. The Rad Monitoring Panel contains the AM System count rate meters and remote switches for the AM System vacuum blowers. The Rad Monitoring Panel also has audible and visual alarm indication for AM System alarms and interfaces between the AM System and The DCS.

Stack Air Activity Monitoring System

The Air Monitoring System interfaces with the Stack Air Activity Monitoring (SAAM) System at the Tank Farm exhaust stack. Since flow due to exhaust venting through the Tank Farm exhaust stack is not constant, the SAAM System relies upon the AM System for constant flow.

The SAAM System contains vacuum blowers at the Tank Farm exhaust stack which withdraw a proportional sample of the air from the exhaust stack. The flow rate of the sample is controlled by flow control valves. Since the sample is proportional to the flow rate through the stack, if there is no flow through the stack, the control valves close completely. If this occurred, the SAAM System vacuum blowers would overheat and become damaged due to no flow. The output from the AM System into the Tank Farm exhaust stack ensures a minimum flow through the exhaust stack, and therefore, a minimum flow through the SAAM System vacuum blowers.

Electrical Distribution

The Air Monitoring System interfaces with the Electrical Distribution System at the Motor control Centers and distribution power panels. The AM System receives power to operate the Vacuum blowers, the radiation detectors, and local alarm panels.

Review

- How does the DCS interact with the Air Monitoring System?
- How does the Air Monitoring System interact with the Stack Air Activity Monitoring System?

INTEGRATED PLANT OPERATIONS

ELO 4.2	**Given applicable procedures and plant conditions, DETERMINE the actions necessary to perform the following Air Monitoring System operations:** **a. Startup** **b. Shutdown**

Normal Operations

System Alignments

There are three types of alignments. These involve initial setup of the Distributed Control System, verification of power to the system from the Electrical Distribution System, and the Air Monitoring System valve lineup. The initial position of switches, breakers, circuits, alarms and valves are specified in Attachment 1, 2, and 3 of procedure 261-SOP-AM-01, Air Monitoring.

System Startup

When starting the building CAM Vacuum Blower, one of the two blowers is selected as the primary blower by positioning the Fan Selector Switch (H-261-AM-HS-6707-(A)) on the Rad Monitor Panel to either FAN-001 or FAN-002. After the "Start" push-button (H-261-AM-HS-6615-(B)) has been pushed, the Point Tag Display should reflect that the selected Primary Blower is running. NOTE: When the "Start" push-button has been pushed, the "Low Flow" alarms will sound until the vacuum blower is at operating speed. The alarms will then clear. The air flow on each CAM is adjusted in accordance with the procedure by adjusting the needle valve mounted on the flow gauge. The Primary Blower inlet, outlet and differential pressures are verified to be in accordance with the procedure.

If the standby blower is required to be put on line, position the Fan Selector Switch on the Rad Monitor Panel to the stand-by CAM Vacuum Blower and depress the “Start” push-button.

When starting the Tank Farm CAM Vacuum Blower, one of the two blowers is selected as the primary blower by positioning selector switch H-262-AM-6707-HS to the desired blower.

CAMs are placed in service by closing breakers on Instrument Power Panel E, which energize one, two, or three monitors per breaker. As each breaker is closed, alarms will sound at the Rad Monitor Panel, and alarms and beacons will be activated on the individual local CAM alarm panel. Each alarm will be acknowledged first at the Rad Monitor Panel then at the local alarm panel.

Normal Operations

During the regular operation of the Air Monitoring System, parameters of the system can be observed and monitored. Air sample activity levels are determined by beta monitors and displayed on the count rate meters. The primary blower inlet outlet and differential pressures, and air flow rate of each CAM station can be monitored by operators locally. DCS receives input of count rate level and high radiation, low flow, and monitor failure alarm status. As long as parameters remain within normal limits, operators should only need to monitor system operation. Due to slow buildup of dust on filter papers, occasional adjustment of CAM flow rate may be required to maintain system at peak performance.

System Shutdown

If the CIF has been shutdown and the CAMs are no longer required, the vacuum system may be secured. The CAM Vacuum Blowers for the CIF and Tank Farm are stopped by pressing the appropriate "Stop" push-button on Rad Monitor Panel 2405-B, for the operating vacuum blower. This will cause the "Low Flow" alarms to activate on each of the CAMs that are in service. The breakers which were closed when placing the CAMs in service should be placed in the open position to secure the "Low Flow" alarms.

Records

Procedure 261-SOP-AM-01, Air Monitoring, contains check lists and sign-off sheets that require completion during start-up, operation, and shut-down of the system. The procedure becomes a Record when completed and shall be processed in accordance with SW-Q1-1171, Records Management.

Infrequent Operations

Infrequent operations include detector source checks, filter paper change, and loop verification and calibration. Source checks and filter changes will be performed by RCO personnel, and the loop verification and calibration will be perfomed by Maintenance.

Filter Paper Change

Periodically, the filter paper from the Tank Farm CAM stations and the CAM stations which were abandoned in place following the implementation of J-DCF-H-00867 will need to be replaced. This should not involve extensive radiological controls based upon the expected levels throughout the facility. If high levels of activity are detected prior to or during the change out, appropriate controls will be implemented to prevent the spread of contamination.

The filters installed in the retrospective mode will also be periodically changed for new ones. This will allow RCO analysis of long term activity levels in the affected areas.

The filter papers installed in the active chambers will need to be changed based upon requirements for flow and radioactivity analysis. If a high radiation alarm is received from an air monitor, the filter paper will be locally analyzed and changed out by the RCO personnel responding to the alarm. The filter paper will also be changed when the weekly source check is performed.

Regardless of the radiological precautions required, RCO personnel will remove and replace the filter papers. The steps involved during the change of filters will require securing flow through the chamber, and the low flow alarm for the affected monitor will be received at the Rad Monitoring Panel and DCS as a result.

Detector Source Check

Source checks of active detectors are required weekly to ensure proper operation. Source checks will be performed by RCO personnel and should be performed in conjunction with filter paper changes. A source check is a procedure where a known radioactive source is positioned for the detector to receive its radiation. By comparing the known source strength to the indicated readings from the detector, the operability of the detector is verified. Source checks may be performed for several strengths of sources or even different orientations or distances for the same source.

Loop Verification and Calibration

This procedure will be perfomed by Maintenance. Its expected periodicity is annually, but may be required to be performed upon failure of an instrument to properly indicate or alarm. The procedure tests and calibrates the alarm functions, indications, and control functions of the Count Rate Meter, and also tests the low flow alarm switch for proper operation. Operators should be made aware of alarms being tested prior to commencing the procedure.

Abnormal Operations

ELO 1.3	**EXPLAIN the consequences of a failure of the Air Monitoring System to fulfill it's intended purpose, including the effects on other systems or components, overall plant operation, and safety.**
ELO 2.4	**Given a description of abnormal equipment status for the Air Monitoring System, EXPLAIN the significance of the condition on system operation.**
ELO 2.5	**Given a description of the Air Monitoring System equipment status, STATE any corrective actions required to return system operation to a normal condition.**

Operator knowledge of expected flow paths and system parameters is required for analysis of proper operation. Because of limited operation of the system and changes being made, actual values for expected instrumentation readings must be surmised from design parameters and fundamental knowledge application.

Low flow conditions

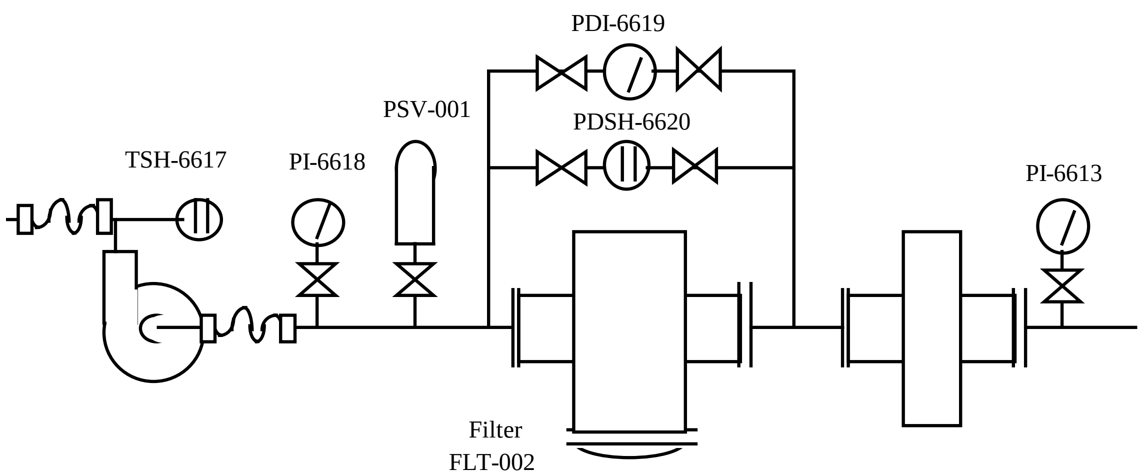
Low flow conditions could be attributed to malfunctioning blowers, improper system valve positions, restrictions to flow in piping, filter clogging, or even failure of check valves leading to back flow through the off service blower. Assuming that the system was properly aligned for operation, the operator responding to low flow conditions should analyze the flow indications available at the CAM stations and pressure indications at the blowers. Multiple low flow conditions indicate problems with the on service blower unit while an individual low flow condition may be localized to the CAM station and its associated piping.

A single low flow condition may be corrected by adjusting the flow control valve, or may require changing of the filter paper. If the low flow condition is alarming at several detectors, or even if there is only a single alarm but all detectors have lower than normal flow, the blower piping and valve positions should be investigated for abnormalities. A problem with a blower would require starting the alternate blower.

High differential pressure across the inlet filter would indicate filter clogging. Abnormal pressures at the detectors may indicate low flow or even abnormal high pressure conditions. Misaligned valves would isolate flow paths, and malfunctioning blowers would not provide adequate force to move the air as required.

While analyzing the pressure indications available, the operator should keep in mind that the piping at the inlet to the blowers should be operating at a vacuum, and the outlet of the blowers may be at a positive pressure with respect to atmosphere. Additionally confusing is that the inlet pressure at the inlet silencers is measured in inches of Mercury (inHg) and the inlet pressure of the blowers is measured in inches of water (inwc). A simplified conversion is that 30 inches of Mercury is roughly equivalent to 400 inches of water.

Example



Pressure at the inlet silencer for the running CIF Building vacuum blower (PI-6613) indicates one half (0.5) inHg vacuum.

Pressure at the blower inlet (PI-6618) indicates nine (9) inwc vacuum.

Differential pressure across the filter (PDI-6619) is two (2) inwc.

Do these values make sense? What is the direction of flow?

First, we must convert inHG to inwc:

$$\frac{0.5 \text{ inHG}}{} \left| \frac{400 \text{ inwc}}{30 \text{ inHG}} \right. = 6.7 \text{ inwc}$$

Then, we can look at the values:

9.0 inwc is at a higher vacuum (lower pressure) than 6.7 inwc, therefore air flow should be from the 6.7 inwc (inlet to the unit) to the 9.0 inwc (inlet to the blower). This is what we want, so it is normal. Additionally, the differential pressure across the filter is 2 inwc, which is approximately the difference between the two inlet pressures, plus some difference for D/P across the silencer and piping.

In the example provided, flow is as expected. If the flow direction was reversed, there would be serious problems with the system. The blower should be providing motive force to push the air in the direction desired, and reverse flow would only be possible if there was a break in the piping or if there was a problem with the check valve.

A loss of all flow at the Tank Farm is serious since the SAAM System relies upon the AM System to provide a minimal flow through the Tank Farm exhaust stack. This interrelation is described in the System Interrelations chapter.

Loss of flow though the retrospective mode and on service monitors would result in loss of time weighted representative samples and automatic sensing of high airborne activity levels respectively. If total system flow were reduced in the CIF Building vacuum blower system, the vacuum blowers may be damaged due to overheating.

Higher Activity Levels

Activity levels which are higher than expected, but below the alarm setpoint could be due to several causes. Higher concentrations of particulate activity will cause higher readings. A rise in the background level in an area will also be sensed by the detectors as a rise in activity levels. Although a monitor may not be alarming, steadily and rapidly rising levels should be investigated to determine possible causes.

Eventually, the levels in the facility may rise over time. This would be due to the build up of contamination during the course of operations. Supervisors should be aware of sudden rises and concentrations nearing alarm conditions in order to take steps to reduce the levels. If the cause is due to rising levels of airborne contamination, efforts should be made to reduce the source of contamination and prevent alarming levels. A steady but slow build up over time may require decontamination or clean up operations to correct.

If radiation levels are above the alarm setpoints and the alarm fails to operate, operators should be made aware of the high level condition and take the same actions as if the alarm were operating. Maintenance should be informed at the earliest opportunity in order to correct the failed alarm. This condition should not be confused with a monitor fail condition, which does not necessarily indicate a high activity level condition.

ELO 3.4	**INTERPRET the following Air Monitoring System alarms, including the conditions causing alarm actuation and the basis for the alarms:** **a. Radiation alarm** **b. High CAM vacuum temperature** **c. High differential pressure** **d. Low flow** **e. Monitor Failure**
ELO 4.3	**DETERMINE the effects on the Air Monitoring System and the integrated plant response when given any of the following:** **a. Indications/alarms** **b. Malfunctions/failure of components** **c. Operator Actions**

Response to alarms will be made in accordance procedure 261-AOP-AM-01, CIF Radiation Continuous Air Monitoring And Vacuum Events.

High radiation alarms

If a high radiation alarm is received from a Val-Tech beta monitor, all personnel will be evacuated from the affected area and the Shift Supervisor will be notified. Radiological Control Operations (RCO) is dispatched to the affected area to investigate the cause of radiation alarms. RCO will monitor the area for high radiation levels, sample the atmosphere for airborne activity, and perform monitoring on the installed filter paper to confirm the presence of a high airborne contamination level. Maintenance is notified when alarms indicate equipment failure.

If there is a liquid release, 261-EOP-03, Low Energy Liquid Release (LELR) is initiated.

If airborne activity is confirmed, 261-GOP-04, Process Shutdown From Normal Operations To Warm Stand-By, may be initiated. Operators entering an area with high airborne contamination levels will be required to wear respiratory protection. Efforts shall be made to determine the source of contamination in order to minimize or stop the spread.

High CAM vacuum temperature

The primary vacuum blower will be switched to the stand-by vacuum blower in the event of a high temperature condition. Causes of a high temperature condition include, but are not limited to High inlet temperature of the sampled air, overheating of the blower due to flow restriction, and electrical faults overheating the motors of the Tank Farm blowers.

High differential pressure

High differential pressure can be indicated by the differential pressure indicator or the differential pressure switch which sense pressures at the inlet and outlet of the filters. A high differential pressure condition should cause the switch to send a signal indicating the condition on the Rad Monitoring Panel and DCS. The high differential condition may also be read locally at the filter. A high differential pressure condition would be caused by excessive flow rate, which is unlikely, or by filter clogging. Upon receipt of a high differential pressure alarm, the standby blower should be started, and the filter which had the high differential condition will need to be cleaned.

Low flow

Causes of low flow conditions are listed in the infrequent operation section of this chapter. If the low flow condition is localized to an individual monitor, the flow is adjusted or the low flow condition will be corrected. If the condition is due to the blower unit malfunctioning, the valve alignment will be checked in accordance with 261-SOP-AM-01, and out of position valves will be repositioned under the direction of the Shift Supervisor. If a breaker supplying a blower is tripped, Maintenance is notified to determine the cause and correct the condition which caused the malfunction.

Low flow conditions may also be caused by operator action. Adjustment of the flow control valve to a low flow condition would cause an alarm. Any magnetic item or piece of equipment which could interact with the magnetic reed switch would cause a low flow alarm if it were placed in close proximity to the low flow alarm switch. Securing flow due to maintenance or securing the running blower will also cause low flow conditions.

Review

- What actions or conditions could cause a low flow alarm?
- What periodic testing is done to the Air Monitoring System?
- What are the expected responses to the following:
    - High Differential Pressure
    - High Vacuum Temperature
    - High Radiation Alarm in the Ashcrete Area
- What could cause High Radiation Alarms?

ANSWERS TO REVIEW QUESTIONS

✈ What is the purpose of the Air Monitoring System?

The Air Monitoring System collects air samples from the process areas and determines airborne beta and gamma activity levels to provide identification of high airborne activity which could be the result of leaks or spills in the facility.

The Air Monitoring System also provides a minimum flow in the Tank Farm Exhaust Stack to prevent damage to the Stack Air Activity Monitoring System vacuum blowers at the Tank Farm.

✈ Which CAM Stations will be modified to the Retrospective Mode?

H-261-AM-RX-6605 at the Box Pusher, H-261-AM-RX-6607 at the Ashout Enclosure, and H-261-AM-RX-6611 at the Kiln Stairway.

✈ Which CAMs will remain in their designed operational mode?

H-261-AM-RX-6604 at the Box Lift, and H-261-AM-RX-6608 at the Ashcrete Processing Station.

✈ Why are the Tank Farm CAMs required to remain in place with normal flow through them?

To provide a minimum flow in the Tank Farm Exhaust Stack to prevent damage to the Stack Air Activity Monitoring System vacuum blowers at the Tank Farm.

✈ From where are the local alarm panels powered?

The local alarm panels are powered from instrument panels B, C, and D.

✈ What type of detector is used for the Air Monitoring System? Why is this type used?

Geiger-M①eller (G-M) gas-filled detectors which can detect both beta and gamma radiation are used because of their high sensitivity to low level beta particles.

✈ What is the planned disposition of the Kanne Monitor?

The Kanne Monitor will be abandoned in place.

✈ Where do high radiation alarms from the count rate meters sound or display?

High radiation alarms from the count rate meters sound at the Local Alarm Panel, DCS, and the Rad Monitoring Panel. The alarms display at the Local Alarm Panels (small alarm light), above the Local Alarm Panels (flashing red light), on the Count Rate Meter itself, DCS, and the Rad Monitoring Panel.

✈ Which instruments have associated alarms? From where do they sense?

The filter differential pressure from across the inlet filter to the vacuum blowers.
The vacuum blower high temperature switch from the outlet of the vacuum blower.
The count rate meter from the beta detector at the CAM station.
The count rate meter from the meter itself (monitor failure).
The flow switch from the flow meter at the CAM station.

✈ What interlock or control features are associated with the vacuum blowers?

The vacuum blowers are relay controlled so that only one vacuum blower for each flow system (CIF Building or Tank Farm) should be in operation at any time.

✈ What other interlocks exist in the Air Monitoring System?

No other interlocks exist which are active. A previous interlock controlled the inlet control valves to the Kanne Monitor.

✈ What alarms are associated with the count rate meters? What conditions cause these alarms to sound?

High Radiation detected from the beta detectors at the CAM Station. This could be caused by:

- high airborne activity sensed on the filter paper of the station caused by spills, leaks, or releases.
- high general area radiation sensed by the detector.
- detector faults.

Monitor Failure. Caused by low output of the count rate meter caused by:

- malfunction
- power failure to the meter

✈ Which alarms sound on the Rad Monitoring Panel? Which alarms sound on Local Alarm Panel? Which alarms sound on DCS?

Rad Monitoring Panel

- High Radiation alarm
- High CAM vacuum temperature
- High differential pressure
- Low flow
- Monitor Failure

Local Alarm Panel

- High Radiation alarm

DCS

- High Radiation alarm
- High CAM vacuum temperature
- High differential pressure
- Low flow
- Monitor Failure

✈ How does the DCS interact with the Air Monitoring System?

The DCS receives signals from the count rate meters for high beta radiation and monitor failure.
The DCS receives signals from the Kanne Tritium detector for high Tritium radiation.
The DCS receives signals from the low flow switches indicating low flow through a CAM station.
The DCS receives signals from the differential pressure switches for high differential pressure across the vacuum blower inlet filters..
The DCS receives signals from high temperature switches for high temperature at the vacuum blower outlets.
The DCS is configured to control the Kanne sample flow valves. Since the Kanne monitor will be abandoned in place, this control may eventually be eliminated

✈ How does the Air Monitoring System interact with the Stack Air Activity Monitoring System?

The Air Monitoring System provides a minimum flow in the Tank Farm Exhaust Stack which prevents damage to the Stack Air Activity Monitoring System vacuum blowers at the Tank Farm.

✈ What actions or conditions could cause a low flow alarm?

Throttling of flow control valves, stopping of vacuum blowers (operator action or loss of power), isolation of flow paths through the CAM station or the vacuum blower units, clogging or blockage of flow at the CAM station or Vacuum blower units all cause low flow conditions which result in low flow alarms. Magnetic interaction between a metallic or magnetic device near the flow switch could cause a false alarm of a low flow condition.

✈ What periodic testing is done to the Air Monitoring System?

Source checks are performed weekly, and loop testing and calibration is performed annually.

✈ What are the expected responses to the following:

- High Differential Pressure

  Switch to the standby blower and change the filter.

- High Vacuum Temperature

  Switch to the standby blower and investigate the cause of the high temperature

- High Radiation Alarm in the Ashcrete Area

  Evacuate the Ashcrete Area, call RCO in order to perform portable and local analysis of radiation and airborne contamination levels. Reenter the area only with proper respiratory protection or with RCO clearance. Investigate the cause of the high airborne condition by looking for leaks or spills.

✈ What could cause High Radiation Alarms?

High Radiation detected from the beta detectors at the CAM Station. This could be caused by:

- high airborne activity sensed on the filter paper of the station caused by spills, leaks, or releases.
- high general area radiation sensed by the detector.
- detector faults.